

## **College Avenue Bridge Analysis December 30, 2003**

### **Programming/Background**

The Wisconsin Department of Transportation (WisDOT) programmed the College Avenue Bridge that spans the Fox River in the city of Appleton for replacement in 2008. This decision was made in 2001 following a bridge inspection completed that year. As a result of that inspection, WisDOT identified a need to replace the bridge in two years or expedite a short-term rehabilitation project and replace the bridge in approximately six years. WisDOT completed the rehabilitation work in December 2002 and programmed the replacement in 2008.

WisDOT and city of Appleton engineering staff met in December 2001 to discuss replacing the College Avenue Bridge. The city was informed that WisDOT's bridge section recommended the bridge be replaced in 2008. WisDOT requested that the city of Appleton take the lead in determining if the bridge would be replaced with a two-lane or four-lane structure since College Avenue is a city street without county or state jurisdictional status. Because the structure needed replacement, WisDOT considered this a logical and reasonable opportunity for the city of Appleton. Replacement allowed the city to consider expansion of the bridge to help support their long-range planning decisions and adequately accommodate current and future traffic and bicycle/pedestrian needs.

### **Analysis of Rehabilitation and Replacement Options**

The College Avenue Bridge replacement was most recently discussed at the November 2003 city of Appleton Municipal Services Committee meeting. At this meeting WisDOT was asked to identify what rehabilitation options may exist in lieu of replacement for the bridge.

The WisDOT Bridge Unit has completed an evaluation and analysis of options. A copy of their summary and findings is attached to this report as [Appendix A](#). A summary of the findings follows:

The College Avenue Bridge has two main steel girders. This steel support system is the critical element requiring that the bridge undergo major rehabilitation or be replaced. Design and construction techniques for some steel bridges designed and constructed in the 1960's have led to problems with cracking in weld areas of the steel beams that support the riding surface or bridge deck. The College Avenue Bridge has these critical elements.

This two-girder system has a welded design that leads to fatigue problems. Fatigue cracking has been found in past bridge inspections of the College Avenue

Bridge, leading to the recommendation to replace the bridge. Fatigue cracking has the potential to develop into a failure in the main support girders and could cause a bridge failure if not detected because of the fracture-critical two-girder system.

The 2002 maintenance project reduced the risk of failure and extends the bridge's life until its replacement could be planned, designed, and constructed in 2008.

WisDOT has increased bridge inspections from a two-year to a one-year cycle. These inspections are critical to detect if cracking is present or if cracks are growing. The interval between inspections could increase in frequency and further load limits could be required as we approach 2008. (A weight limit of 40 tons was posted November 1, 2001. Forty tons is the maximum legal load allowed on the bridge. Before the posting, heavier loads could cross under permit. Those heavier loads are no longer allowed to use the bridge.)

The attached bridge report in [Appendix A](#) provides additional information on the bridge condition and history.

### **Short-term Rehabilitation**

The bridge report addresses short-term rehabilitation as alternatives entitled "Do Nothing" and "Structure Rehabilitation – Additional steel repairs/retro-fits". In summary, short-term rehabilitation is not acceptable in terms of cost or safety.

#### **Short-term Options:**

##### **1) "Do-Nothing"**

The "Do-Nothing" option continues to maintain the existing bridge and would not eliminate the fracture-critical condition of the support beams. Fatigue cracks too small to detect could, with time and continued traffic loading, grow into detectable cracks. This option would lead to frequent inspections and costly repairs without the elimination of the risks involved. Inspections will also require frequent lane blockages for equipment access to perform the work, resulting in increased disruption to traffic.

## 2) **Retro-fit Option**

The “Additional steel repairs/retro-fits” option, while doable, is not considered an economically prudent alternative. Under this option, all welded locations on the support beams would need to be retrofitted with bolted cover plates. The cost of this option will exceed the cost to completely replace the bridge. In addition to the high initial cost, this alternative also leads to higher total costs due to an accelerated maintenance schedule for continual repairs to the piers, future repairs to the roadway surface, and other beam maintenance items (such as painting) over the remaining life of the bridge.

### **Long-term Options**

The bridge report also identifies four long-term options, including rehabilitation of the existing structure, replacement with a two-lane structure, and replacement with a four-lane structure. These options do not consider other needs, such as traffic needs and long-term maintenance costs. All of these options should result in a bridge life equal to that of a new bridge.

#### **Long-term Rehabilitation Options:**

##### 1) **Rehabilitation – Existing Two-lane – Cost \$5 million**

The first option, “Structure Rehabilitation – Superstructure Replacement”, involves replacement of the steel-girder system and driving surface and repairs to the support columns or piers as needed. This option, due to the limitations of the existing piers, could not provide for a wider roadway to accommodate current and future traffic needs or improved bike and pedestrian accommodations.

Cost in today’s dollars is estimated at \$4.05 million, plus an estimated \$1 million in engineering and contingencies, bringing the rehabilitation cost of this option to an estimated **\$5 million**. This option would require additional repairs to the remaining support columns on a recurring cycle (estimated at approximately every ten years) thus adding additional costs.

##### 2) **Rehabilitation – Four-lane – Cost \$9.5 million**

The second option, “Structure Rehabilitation – Superstructure Replacement and Widening”, involves replacement of the steel girder system and driving surface, and includes widening of the bridge width to accommodate four lanes of traffic.

Cost in today’s dollars is estimated at \$8 million in bridge costs, plus an estimated \$1.5 million in engineering and contingencies, bringing the estimated rehabilitation cost of this option to **\$9.5 million**.

### Long-term Bridge Replacement Options:

**3) Replacement – Two-lanes – Cost \$4.8 million**

The third option identifies the cost to replace the bridge with a two-lane structure. This cost is estimated at \$3.8 million in bridge costs, plus an estimated \$1 million in engineering and contingencies, bringing a new two-lane bridge replacement cost to an estimated **\$4.8 million**.

The new two-lane bridge estimated cost is basically the same as the initial estimated cost to rehabilitate the existing structure. One reason this is possible is replacement allows for use of pre-stressed concrete beams in lieu of more costly steel beams in a rehabilitated structure. These beams are less costly and require less maintenance than steel. New piers would eliminate the need for continual maintenance on the existing piers of a rehabilitated structure.

**4) Replacement – Four-lanes – Cost \$6.8 million**

The fourth option identifies the cost to replace the bridge with a new four-lane structure. This cost is estimated at \$5.5 million in bridge costs, plus an estimated \$1.3 million in engineering and contingencies, bringing a new four-lane replacement cost to an estimated **\$6.8 million**. Pre-stressed concrete beams would also be incorporated into this structure.

### Traffic Volumes/Projections

Traffic projections for the College Avenue Bridge were re-evaluated in November 2003 to assure the predicted volumes were developed using the best data available with logical and correct assumptions. WisDOT, East Central Regional Planning, and the city of Appleton jointly completed this effort. The projected traffic volumes for the College Avenue Bridge are 23,900 vehicles per day in 2010; 28,500 vehicles per day in 2020; and 33,000 vehicles per day in 2030.

The process for developing the traffic forecast was made using the Fox Cities travel demand model. The model-based projections result from using the best available method to predict traffic volumes. The model is very complex, with numerous best practice techniques built into it. A primary model input factor is the future land use in the Fox Cities urban area that the model represents. This area includes Appleton, Neenah, Menasha, Kaukauna, Little Chute, Kimberly, and surrounding townships. Data used to estimate trip generation in the model is zone based on input for projected population, dwelling units, autos, school enrollment, and employment locations. The zonal data assumptions used in the travel model are derived from the Long Range Transportation / Land Use Plan, Fox Cities Urbanized Area, 1997. The model was calibrated using the 1994/1997 coverage counts and with the local future land use plans and socio-economic data.

Recent traffic data for the College Avenue Bridge substantiate these projections as reasonable. In 2002, city data showed the College Avenue volume for the bridge was at 21,000 vehicles per day. In 2003, city data showed the volume increased to 23,100 vehicles per day. It should be noted that the recent city traffic counts, while not used in the travel model to forecast projected traffic volumes, do substantiate the projections.

The recent data is valid and significant when compared to the historic three-year cycle coverage counts from WisDOT. The three-year coverage counts are part of a WisDOT effort to collect traffic data for all significant roadways on a recurring basis.

The more recent data results are attributable to the changes that have occurred in the area. These changes reflect the recent and continued economic growth in downtown Appleton, including:

- The complete reconstruction of College Avenue in downtown Appleton.
- New storefronts, businesses and a hotel have been or are about to be added to the area.
- The new PAC is open.

Major land use/traffic generators have been and continue to be added along the College Avenue east and the John Street/Calumet Street corridors. Recent street projects on County KK, Calumet Street, Kensington and Eisenhower Drive have driven major land use and traffic pattern changes. These include:

- Menards on County CE.
- Wal-Mart, Home Depot, and Kohls on County KK.
- Shopping centers, restaurants, and corresponding adjacent businesses developed and are developing in all these areas.

The City Planning Department also compiled a list of recent or planned developments that validate the traffic growth and data. A copy of the College Avenue Bridge traffic projection is attached as [Appendix B](#). The list of the recent or planned developments is attached as [Appendix C](#).

## **Capacity Analysis**

WisDOT believes the projected traffic volumes for the College Avenue Bridge are logical, incorporating accurate research methods and valid assumptions. These projections were also used to evaluate the level of service that would result for the segment of College Avenue between the College-Walter-John Street intersection and the College-Meade Street intersection.

Design guidelines for urban improvements and the Federal Highway Administrations (FHWA) criteria for participation in project funding identify the traffic volumes that will provide a minimum acceptable level of service for new construction. The criteria are based on traffic volumes in the design year, or twenty years beyond the construction year, and average vehicle speed for the roadway segment. Speed is impacted by factors including traffic volumes, traffic signal density, intersection delays, and signal timing.

The WisDOT Facilities Development Manual identifies maximum vehicle-per-day traffic volumes for two-lane urban arterial and collector streets that will provide the minimum acceptable level of service for new construction to be between 9,500 vehicles per day to 24,500 vehicles per day. A copy of the urban design criteria is attached as [Appendix D](#).

The FHWA informed WisDOT they would not participate in the funding for a bridge that would in fact be inadequate to accommodate current or projected traffic needs. The section of College Avenue between the College-Walter-John Street intersection and the College-Meade Street intersection, including the bridge, will not provide an acceptable level of service for a two-lane roadway based on the projected traffic volumes.

### **Project Schedule**

WisDOT has currently programmed funds to address the College Avenue Bridge in 2008. This schedule depends on the selection of a consultant firm to complete the design.

The following is WisDOT's projected schedule for a replacement bridge project. The start of this schedule is driven by the determination of the project's scope and design parameters. A critical element of the scope is the number of lanes for the bridge and roadway.

Elements of Delivery Schedule	Length (Months)	Possible Completion Date
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Selection of engineering firm	1 month	April 2004
Negotiation of design contract	2 months	June 2004
Preliminary design	18 months	January 2006
Final design	24 months	January 2008

Based on the above schedule, a bridge replacement project would most likely occur in 2008 and be completed in 2009. WisDOT believes this schedule can be maintained if the question on the number of travel lanes can be finalized by the spring of 2004.

### **Transfer of Ownership**

The bridge is owned and maintained by WisDOT under the provisions of State Statute 84.10. It is WisDOT's policy that ownership of these bridges be transferred to the local unit of government with jurisdiction of the roadway upon replacement of these bridges. State Statute 84.16 was enacted to allow for jurisdictional transfer of WisDOT bridges not on the state trunk system from the state to the local unit of government. This policy is applied statewide and has been applied to other bridge replacement projects in the Fox Valley. WisDOT does expect that ownership would transfer upon replacement of the College Avenue Bridge as well.

A copy of the section from [WisDOT's participation policy](#) on replacement and transfer of ownership of 84.10 bridges, and a copy of [State Statutes 84.10 and 84.16](#) are attached to this report as E and F Appendices respectively.

Under the participation policy for 84.10 bridges, WisDOT would replace the existing bridge in kind with minimal cost to the city. This is based on federal funds being available for the project. WisDOT had prepared an estimate for replacing the bridge with a two-lane structure and provided the city with what their share cost would be. That cost share would no longer be valid if federal funds were not available.

### **Typical Maintenance Costs**

A copy of estimated routine bridge maintenance costs for a typical bridge is attached as [Appendix G](#). The information contains short term recurring costs and typical intervals for these costs to occur. These short-term items include deck sealing, deck and joint cleaning, and routine bridge inspections.

It also identifies time frames and costs for longer term and less frequent maintenance items, such as deck patching, deck overlay, and deck replacement. The higher cost maintenance repairs associated with deck overlays and deck replacement typically would have federal funds available to help finance these repairs. Federal dollars are generally eligible to fund 80 percent of the repair costs.

### **National Highway System Status**

College Avenue is on the National Highway System (NHS). This system was established by Congress to provide an interconnected system of principal arterial routes. The FHWA views this as a priority system of highways on which to focus federal involvement, ensuring connectivity to other significant regional transportation routes and also assuring a uniform high level of safety, design, and operational standards. The NHS system was also developed to recognize corridors for disaster and emergency management, economic enhancement, and system connectivity that include crossing barriers such as the Fox River.

College Avenue was identified and included in this system because it could provide a four-lane corridor that would afford the urban area with connectivity from WIS 441 west to the Outagamie County Regional Airport, including a connection to US 41.

WisDOT discussed the College Avenue Bridge project with Mr. Johnny Gerbitz, FHWA's district representative. He informed WisDOT that any replacement of the College Avenue Bridge should meet design standards regardless of funding used because of its importance to the NHS system. He stated the traffic volumes projected for the bridge dictate a four-lane bridge should be constructed and cautioned they would not approve the use of federal-aid funding for a structure replacement project which does not meet design standards unless there is rigorous justification.

## **WisDOT Recommendation**

The College Avenue Bridge is unique. It is a state owned bridge, located on an arterial street under city jurisdiction, and on a federally established NHS. The involvement of various government agencies has the potential to complicate any determination for this structure's future.

Short-term rehabilitation is not an option due to the safety risks associated with the bridge's present steel beam system. Based on all the data available, WisDOT does not consider rehabilitation to be an economical, reasonable or prudent option for the taxpayers of the city of Appleton or the state of Wisconsin. WisDOT believes replacement is the only reasonable option. The department's position is to replace the bridge in lieu of long-term rehabilitation. The initial cost of a new bridge will be equal to or less than a rehabilitated bridge. It will also have significantly reduced maintenance costs and needs. In addition, rehabilitation options cannot address more desirable and safer accommodations for pedestrian and bicycle modes of transportation, nor does it offer the ability to provide for minimal acceptable traffic needs for the bridge or the College Avenue corridor.

There are questions regarding the impact of a wider bridge to the surrounding neighborhood. A new structure located on basically the same alignment as the present bridge would need minimal added right-of-way from residential areas. Impacts, especially on the western approach to the bridge, should be minimal. In addition, Community Sensitive Design standards incorporated by WisDOT allow consideration for narrower lanes or other methods to help mitigate the common concerns of citizens residing adjacent to the roadway.

Based on all the data and discussion regarding this project, WisDOT believes a four-lane bridge is warranted in this situation. Our guidelines show a four-lane facility should be considered for the traffic volumes predicted on College Avenue. In our opinion, it is the prudent and economical option when considering the initial and life-cycle costs for this structure.

WisDOT recognizes the concerns of the city in regard to transfer of ownership upon replacement of the bridge. This policy has been in effect for many years and has been applied to many bridges in other communities. This policy does apply to the College Avenue Bridge.

There are many questions and concerns about the life span of the existing bridge and why it has not provided a bridge life expectancy in the 70 to 80 year range. The reason lies in the design and construction issues associated with this bridge that were acceptable in the 1960's. This type of design was acceptable at that time, but experience has shown it leads to problems and has resulted in a shorter life span. The bridge was built, owned, and maintained by WisDOT to meet all the local needs during its life. It is structural concerns that cause WisDOT to require its replacement. We can expect any new bridge



to last 70 years, if for no other reason than our engineering and construction materials are better today than they were in the 1960's.

As expressed earlier, the FHWA has indicated they would not fund any bridge rehabilitation or replacement that would not meet the minimum acceptable level of service for the design year (2028) projected traffic. In addition, they have stated that, regardless of their funding decision, all structure replacements on the NHS system must be constructed to meet accepted standards unless rigorous justification can be provided.

WisDOT finds that the FHWA position and comments present an additional concern for maintaining a two-lane structure. Traffic volumes, projected growth, and safety of an expanded facility help justify replacement of the bridge to accommodate four lanes of traffic. FHWA normally does not make their final decision until the conclusion of the environmental process, a process that begins with the start of the design process and typically stretches from 18 to 24 months. If a decision is made to replace the bridge with a two-lane structure and FHWA will not participate, WisDOT will negotiate a cost share for the new structure with the city.

Again, WisDOT believe that any replacement of this bridge should be made to accommodate four lanes of traffic. It is the prudent and economical option when considering the initial and life-cycle costs for this structure. This position is also based on an analysis of the existing and projected traffic volumes, expected life expectancy of any major bridge replacement, and predicted future growth and development of Appleton and surrounding urban areas. It follows the recommendation of the Fox Cities planning study that the city helped to produce.

WisDOT has worked cooperatively with the city for many years in developing and maintaining an excellent transportation system for Appleton and the Appleton urban area. This is consistent with our intention for the College Avenue Bridge. The department recognizes that expansion of the College Avenue Bridge is an important issue and appreciates the interest and involvement of all its citizens in this process to determine the bridge's future.

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